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THE NATURE AND PROPHYLAXIS OF THE FEVERS IN THE DINAJPUR DISTRICT

Leonard ROGERS

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During the past few years the district of Dinajpur has been the theatre of a most serious and widespread epidemic of fever, which has been the cause of the death of many thousands of people. The nature and origin of this epidemic has been the subject of much discussion, and it is the object of this paper to give a summary of the results of the investigations made by the author during the past few years. The epidemic is characterized by a sudden onset, with a high fever, headache, and a general prostration of the system. It is most prevalent in the hot season, and is especially fatal in the case of children and the aged. The epidemic is not confined to any particular part of the district, but is widespread throughout the whole. It is not accompanied by any special symptoms, such as skin eruptions or swellings. It is not contagious, and it is not caused by any special food or drink. It is not caused by any special exposure to cold or wet. It is not caused by any special exposure to heat or sun. It is not caused by any special exposure to malarial or other fevers. It is not caused by any special exposure to any of the causes which are usually associated with fever. It is a new and distinct epidemic, and it is the object of this paper to give a summary of the results of the investigations made by the author during the past few years.

A more detailed account of the epidemic will be given in the next paper, and it is the object of this paper to give a summary of the results of the investigations made by the author during the past few years.

* Part II of this subject appears in a subsequent paper.

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Recommendations.

I would recommend—

- (1) That glycerinated lymph should be substituted for vaselinated lymph in the Punjab.
- (2) That the glycerinated lymph should first be treated with chloroform.
- (3) That a central lymph depôt should be established in Lahore from which lymph could be supplied to the districts of the Punjab.
- (4) That all vaccinators should undergo a course of training at the Central Depôt

THE NATURE AND PROPHYLAXIS OF THE FEVERS IN THE DINAJPUR DISTRICT.

BY LEONARD ROGERS, M.D., M.R.C.P., F.R.C.S.,
CAPT., I.M.S.

I—THE VARIETIES OF FEVER MET WITH.

It has already been mentioned in the first part of this report* that the enquiry was carried out in the minimal fever season, and that the village enquiry occupied the major part of my time. Nevertheless, a few cases of fever were met with attending the Dinajpur dispensary; the blood of which was examined for malarial parasites, while on two occasions a number of chronic fevers in the most feverish part of the district were examined by means of spleen puncture for the recently described parasite-like bodies found last year in chronic fevers by Leishman and Donovan, and more recently in a case from Sylhet by Manson and Low.

ing place in which to examine this question, for as I showed in my report on *Kala-azar*, that epidemic took its origin in a very severe outbreak of fever in the Dinajpur and Rangpur districts in the early seventies, owing to a succession of very unhealthy years, on account of deficient rainfall. The brief description as yet published by Donovan pointed to a close resemblance between his cases and *Kala-azar*, and he has recently suggested that they may be the same disease. For purposes of searching for this new parasite, it is necessary to do a spleen puncture, as they have not yet been found in the peripheral circulation. This little operation is without danger if properly done, but it necessitates being able to examine the cases in a hospital and careful antiseptic precautions. For over a month a careful watch was kept for suitable cases in the Dinajpur in-door dispensary, but no such case presented itself. On discussing the question with Captain Megaw, I.M.S. (to whom I am very greatly indebted for much help throughout my investigation, both in getting me cases and in helping in the microscopical examination of some of the slides) he informed me that he had seen a number of such cases at one place only, and that was Ranisankail in the north-west part of the district. When at this place on the village enquiry a number of such cases were met with in the villages around, and they came to the dispensary, which was the most popular one in the district, and by means of anaesthetising the surface of the skin with anethyl chloride spray, spleen puncture was readily performed, even in children, in a painless manner and without the slightest difficulty on the part of the patients, except in so far that some

TABLE VII.—CHRONIC MALARIAL FEVERS.

No.	Sex.	Age.	Duration of fever.	Recent fever.	Anæmia.	Darkening of the skin.	Enlargement of the spleen.	Liver edge below ribs.	Wasting.	Malarial parasites.
1	M.	7	3 years ...	Slight ...	Slight ...	Very dark ...	Beyond navel ...	Nil ...	Thin ...	Mal. tert.
2	"	7	2 " ...	Frequently ...	Do. ...	Extremely dark ...	A. S. S. ...	1" ...	Do. ...	Do.
3	"	12	2½ " ...	Every day ...	Marked ...	Dark ...	To navel ...	" ...	Do. ...	Do.
4	"	14	2 " ...	Do. ...	Do. ...	Nil ...	Beyond navel ...	Nil ...	Nil ...	Do.
5	"	8	3½ " ...	Frequently ...	Very marked ...	Dark ...	A. S. S. ...	1" ...	Thin ...	Crescents.

A. S. S. equals down to the anterior superior spine of the ilium.

Firstly, with regard to the kinds of malaria met with, the commonest variety was the malignant tertian form just as it is in Calcutta, and most parts of India. One case of benign tertian was also found in Dinajpur. During the village enquiry a history of quartan fever was obtained in a number of cases in the circle, a few miles to the east of the town, and these cases were usually of a chronic nature, terminating fatally after several months of fever. During my last visit to Ranisankail, a patient came to the hospital with a history of fever of the quartan type, and having suffered from an attack two days before. An examination of his blood showed typical quartan parasites, some just beginning to sporulate, which would correspond with his statement. These cases are probably much more common in the rainy season, and are of interest in connection with the finding of A. Listoni in the district to be mentioned presently, for in the Duars the Malarial Commission found quartan fever to be the commonest type, and to be also associated with the same species of anopheles. All three varieties of malaria were thus met with in the district even in the dry season, but it is not possible to deduce accurately the relative prevalence of each from the few cases found at this time of the year.

A more important question to solve was whether the Leishman-Donovan bodies could be found in chronic fevers in this district, and, if so, the frequency, of their prevalence and how to differentiate from ordinary chronic malaria. Dinajpur was an especially interest-

without fever were disappointed at not being submitted to the new treatment. On a subsequent occasion, a second series were done at the same dispensary, every case with any considerable enlargement of the spleen and recent fever being taken without any selection, the histories of the cases being also carefully recorded. These cases taken as a whole were exactly those which have always been considered to be "Malarial Cachexia," some of them presenting as great enlargement of the spleen and liver, accompanied by general wasting and darkening of the skin, as is seen in typical cases of *Kala-azar* or *Kala-duk* when they were considered individually. Others of the cases only presented comparatively slight enlargement of the spleen, such as invariably results from repeated attacks of malarial fever. Including one case examined later in the Dinajpur hospital, 30 in all were submitted to spleen puncture, and in most of them a slide was also made from the peripheral blood, and examine for malarial parasites, and a differential leucocyte count made. In this way, it was expected that it would be possible to get some clear ideas as to the differentiation of the class of cases in which the new parasites were found from the malarial cases. The results obtained can best be shown by tabulating them in groups.

It will be seen that these cases were of a very chronic type of fever, and all showed the malignant tertian variety of malarial parasite and marked splenic enlargement. Nos. 2 and 4 also showed marked increase of the large mononuclear white corpuscles, namely, 14 and 7 per cent., respectively. No. 3 showed 9 per cent. and No. 5 only 6 per cent.

* Part II only of this valuable report is published here.—
Ed., I.M.G.

TABLE VIII.—CHRONIC FEVERS SHOWING LEISHMAN-DONOVAN BODIES.

No.	Sex.	Age.	Duration of fever.	Present fever.	Anæmia.	Darkening of the skin.	Enlargement of the spleen.	Liver below ribs.	Wasting.	Leishman-Donovan bodies.
1	F.	4	15 months	Daily	Very marked	Dark	A. S. S.	1" ...	Extreme	Numerous.
2	M.	15	1 year	Do.	Marked	Very dark	Beyond navel	1" ...	Do.	Scanty.
3	"	25	2 years	Slight	Slight	Dark	4" ...	Nil	Slight	Numerous.
4	"	15	7 months	Daily	Do.	Do.	Beyond navel	Do.	Extreme	Scanty.
5	"	40*	2 years	Do.	Do.	Nil	4" ...	Do.	Thin	Numerous.
6	"	14	1 month	Do.	Do.	Do.	To navel	1" ...	Nil	Scanty.
7	"	8	1 year	Do.	Very marked	Do.	Do.	Nil	Extreme	Do.
8	F.	7	1 month	Do.	Marked	Dark	Beyond navel	4" ...	Thin	Numerous.
9	"	6	1 year	Do.	Slight	Nil	A. S. S.	4" ...	Extreme	Scanty.
10	M.	8	1 "	Nil	Marked	Dark	Do.	1" ...	Do.	Do.

Died of pneumonia. Bodies found in spleen, liver and bone marrow *post-mortem*.

The above table shows a very similar class of cases to those in that of the malarial series, and also a very great variation in the duration of the disease. Thus in cases 6 and 8, the fever had only lasted one month, and no marked cachexia was present, although the spleen in both cases was very large for such a duration of fever being down to the navel. In No. 8 the temperature was 100·2 at the time the spleen puncture was performed, and the slides contained the largest number of bodies met with in any case in the Dinajpur district. In both series of cases darkening of the skin was a marked feature of the majority, and in some instances the patients or their relatives volunteered the statement that the skin had become darker recently. In nearly all of both series there was distinct and often extreme wasting, the face and limbs being very thin, and contrasting with the large abdomen, presented the typical picture of the condition always known as "malarial cachexia," but this remark is equally applicable to those which showed only malarial parasites as to those which presented the new bodies recently described. In short, these examinations throw no light on the very difficult question of the differentiation of the malarial cases from those which are presumably due to the new bodies, admitting for the present that they are parasites, as they appear to be. It is of course possible that all these chronic cases may be due to the new bodies, and the presence of malarial parasites in some of them was an accidental complication. It appears to be more likely, however, that the new bodies are a form of protozoa very closely allied to the malarial parasites, and producing a very similar train of symptoms, but with a greater tendency to produce rapid cachexial state, and with a greater resistance to the action of quinine in ordinary doses. In view of the above results, it is clear that the differentiation of the two forms by purely clinical means apart from spleen puncture will be a matter of extreme difficulty, and will require a study of a much larger series of cases than the present one. The fact that one third of these cases showed the new parasite is sufficient to prove that it is present in a large proportion of these chronic fevers. On the other hand, in no less than half the cases, neither malarial parasites nor the new bodies could be found even by spleen puncture, although all but two of the patients gave a history of fever continuing for a long time up to the date of examination, and chiefly occurring at night, or in the evening. It is clear, then, that no more can be said than that the new parasite-like bodies can be found by spleen puncture in a number of chronic fever cases, with large spleen in the Dinajpur district, and that no distinction can at present be made out between the symptoms seen in these cases, and in

those due to repeated attacks of malaria, in which malignant tertian parasites were found.†

With regard to the nature of the bodies found in the former cases, there is little to be said; for in view of the fact that such authorities as Laveran, Ross and Manson are at complete variance as to the classification of them, it is useless to add one more to the opinions already expressed with regard to their nature. I will only say that nothing like a trypanosome was ever seen in any of the cases, either in the peripheral blood, or in that drawn direct from the spleen during life. I hope to be able to submit coloured drawings and specimens to high English authorities on protozoa very shortly, in the hope that they will be able to throw some light on the question, but in all probability some of the stages of the parasite have still to be discovered.† The form most frequently seen is a small oval body slightly longer than it is broad, measuring about one-third the diameter of a red blood corpuscle in its longest axis. It has two nuclei, one of which is small and often rod-shaped and stains deeply, while the other is rounded, considerably larger, but more feebly stained. They are free in the blood from the spleen and in most of the cases are scantily met with, but in exceptional instances, and usually in cases which showed an actual fever at the time the blood was taken, they may be very numerous, a number of them being seen in some fields. In addition to this common form, small groups of similar bodies are met with clumped together, so as to very closely resemble a quartan sporulating body, some of them being in the act of breaking up. A still earlier stage is sometimes seen in which pairs of unequal sized nuclei are grouped within a single cell, but no separation into the small bodies is yet to be distinguished. These last bodies are somewhat larger than the largest of the simple forms, and appear to be formed by a subdivision of the nuclei of the largest of the full-grown small forms. I have not been able to detect these bodies in the peripheral circulation by examination of ordinary blood films, but this would not exclude the possibility of their being present in small numbers there. They may be found within the polynuclear white corpuscles, and be thus undergoing degeneration, which is of interest in connection with the very great reduction of the total leucocytes, and especially of the polynuclears in these chronic fevers which I have previously pointed out.

KALA-DUKH AND KALA-AZAR.

In accordance with my instructions to visit the Kala-dukha area of Purnea district, I made enquiries from the district authorities as to the parts at present affected by the disease, and was informed by the Civil Sur-

* Since my return to Calcutta, I have been able to find these parasites in still larger proportion of this class of cases, nearly every case of so called "Malarial Cachexia" having shown the new parasites in the spleen, while they could not be found after death from other diseases.

† Since the above was written the author himself has shown that the Leishman-Donovan bodies are stages in the development of a trypanosome, v. *I. M. G.*, October, p. 386.—*Ed., I. M. G.*

geon, Captain Hayward, I.M.S. that it was to be found in the north of the Kissenganj subdivision. I wrote to the Subdivisional Officer for information some three weeks before I intended to start for the Purnea district, but did not receive any reply until after my return from a fruitless search for the disease, and then was informed that it had died out of the district. During my visit to the area under the kind guidance of Captain Hayward, evidence was obtained of the spread of the disease in a northerly direction, for at Aloobaree it had been present eight years ago, while eight miles further north at Chapra, it has disappeared only three years ago. On reaching Thaurganj, 16 miles north-west of the first-named place, search was made for cases in the neighbouring villages, which were badly affected by the disease at the time of the enquiry made by Major Harold Brown in 1898, but here we were informed that it had disappeared a year ago, and two persons who had suffered from the disease were shown me, one of which had been free from fever for a year and appeared to be nearly completely recovered from its effects, while the other had had no fever for six months, but was still thin, and his spleen reached nearly to the navel. No cases still suffering from fever could be found, so no spleen punctures could be performed with any hope of finding the new parasite like bodies.

On the other hand, thanks to the kindness of Dr. Dodds Price of the Nowgong district of Assam (who helped me so materially in my enquiry into the nature of Kala-azar in 1896-97) in very kindly sending me slides made from blood obtained by spleen puncture in seven cases of Kala-azar, I was able to search for the new parasites in these cases. The results are shown in the following table, one slide was spoilt in trying a new fixing agent:—

TABLE IX. KALA-AZAR CASES*

No.	Duration of disease.	Parasites.
1	7 months ...	Numerous
2	3 years ...	Ditto.
3	2 " improving	Nil.
4	5 months ...	Numerous.
5	" " ...	Scanty.
6	2½ years ...	Do.

It will be seen from this table that the new bodies were found in every case except one, which was improving, and in which recovery was expected to take place. They were more frequently present in large numbers in this series than in the Dinajpur cases, but no differences in the appearances they presented could be made out in the two series. Since these observations were made a paper by Dr. Bentley, of Assam, has appeared announcing that he has also independently found the Leishman-Donovan bodies in Kala-azar cases, and abandoning the theory he advanced a little over a year ago that Kala-azar was a severe form of Malta fever.

The importance of these observations lies in the fact, which I pointed out several years ago, that single cases of the Assam epidemic disease were indistinguishable from cases of ordinary "Malarial Cachexia," so that the discovery that a protozoal parasite (differing from that of malaria and producing the same condition as repeated attacks of malaria causes), is to be found in many cases of "Malarial Cachexia," and in the communicable form of the disease in Assam will fit in with the known facts. So far the new form of parasite has not been found to contain pigment, so that if this is confirmed, then it will be certain that in both the endemic and the epidemic form of the new fever, malaria must be a nearly universal complication, for I showed both in Assam in the case of Kala-azar, and in Calcutta in the case of "Malarial Cachexia," that melanotic pigment characteristic of malaria is, in my experience, always to be found in the organs *post-mortem* in both

series of cases. Possibly it may prove that the new parasites are a secondary infection in patients already infected with malaria, which is so well nigh universal in both Eastern Bengal and Assam, but such points can only be cleared up by further investigations. From the practical point of view, the most important inference lies in remembering that quinine in large doses is the only drug which will cure these chronic fevers, although it undoubtedly not infrequently fails in neglected cases. Further, as demonstrated by Dr. Dodds Price, of Nowgong, the drug is undoubtedly an efficient prophylactic against the disease; for while carrying out the segregation measures I recommended (which proved eminently successfully in getting rid of the infection of coolie lines), he found that his hospital assistants and menials in the Kala-azar camp one after the other contracted and died of the disease. He then took to dosing them regularly with quinine, after which, in the course of several years, he only lost one man, who had become infected before the quinine administration. If it is such a powerful prophylactic, it can hardly fail to have curative effects in big doses in early cases of the disease, so that the measures which will be of value in preventing this class of fevers will be the wide distribution of quinine, as in malarial fevers.

VARIETIES AND DISTRIBUTION OF ANOPHELES.

The facts collected bearing on the presence of malarial-bearing mosquitoes in different parts of the district may next be dealt with. A careful study of this part of the question was first made in Dinajpur town, and subsequently the varieties found in different circles in the district were worked out. As Stephens, Christophers and James have shown that the varieties of anophèles present in any district play a very important part in the etiology of malaria, it is necessary to ascertain the proportion of the different kinds as well as the total number of the anophèles present. Thanks to the recently published book of the two first-named authors, this is not such a difficult task as it was a short time back. In searching for anophèles, it is necessary to ascertain both their breeding places and also the numbers actually met with in the houses of the people. The latter was done with the aid of the Municipal Overseer, who rendered great assistance in the matter. In the month of January, when this survey was carried out, the breeding places were limited to the rivers which run past and through the town, and the tanks within it, which are not very many in number. The former include a very sluggish weed overgrown stream and a canal of a similar nature, which run through the eastern part of the municipal area, while it is bounded on the west side by the river. There are several good brick-lined drains in the town, but most of the roads still have only earth surface ones, which always retain water, and form the most important breeding ground for anophèles in the rainy seasons, so that the distribution of the different varieties will be very much more widespread at that time than they were at the time of my inquiry.

In all no less than five varieties of anophèles mosquitoes were actually caught in the houses. That which was by far the most commonly met was *A. Fuliginosus*, as will be seen from the table below. Next came *A. Rossii*, although this variety was only present in large numbers in the houses near the tanks in the centre of the town. The next most frequently met with was *A. Listoni*, and this is probably the most important of all, for the Malaria Commission found it to be associated with a very high prevalence of malaria in the Duars, where it was the most common anophèles met with, and the only one which they found to be naturally infected. It has not hitherto been found south of the Jalpaiguri district as far as I know, so its presence throughout all the most malarious parts of Dinajpur is noteworthy, for although only found in small numbers during my visit from January to March, yet there are good reasons for believing that it may be present in

* This observation has since been confirmed in two further series of slides from Kala-azar cases.

much larger numbers in the rainy fever season. In the first place, this variety breeds exclusively in running water, so that its breeding places in the cold dry season are limited to the streams on either side of the town. In the rainy season, however, there will be numerous flowing streams and earth-lined drains which will afford it adequate breeding grounds throughout the town. Once more in the Punjab, Major Adie has shown that, although in the dry season *A. Fuliginosus* is the common anopheles met with, yet in the rainy fever season, it is nearly entirely replaced by the *A. Culicifacies*, which belongs to the same group of small dark malaria carrying mosquitoes as does the *A. Listoni* met with in Dinajpur. It is probable, then, that this dangerous variety is much more common in the fever than it is in the dry season. The other two varieties met with in the houses are of much less importance, for they belong to the wild group, which breed in swampy places and rarely enter inhabited houses, while they have never yet been found to be carrying malaria under natural conditions. These are the *A. Barbirostris* and *A. Sinensis*, the latter having only once been found in the houses, although their larvæ were met with not very rarely in weed-grown streams and canals, especially to the east of Dinajpur.

With regard to the breeding places of these varieties, it may be said that *A. Fuliginosus* was met with in both the streams and also in weed-grown tanks. *A. Rossii* in the tanks most commonly, *A. Listoni* chiefly in the sandy river to the west of the town, especially close to the grassy banks, but they must also have been breeding in the more sluggish streams to the east, as they were caught in the houses of that part of the town. The other two were found in the weedy streams as already mentioned. While making collections in the houses in different parts of the town, striking differences in the local distribution were met with. Thus, while *A. Rossii* abounded in the central tank strewn portion, and *A. Fuliginosus* and *A. Listoni* near the streams on either side of the town, there was a dry zone between the central and the western portions in which a very careful search failed to reveal a single anophele. Moreover, the more intelligent inhabitants of the riverine portion, where most *A. Listoni* were found, were convinced that this was the most malarious portion of the town in the rainy season, although this was not evident at the time of my visit in the dry healthy season.

Turning next to the distribution of the anopheles in the district circles, which is illustrated in Table X, we find the *A. Fuliginosus* to have been the common variety in all parts of the district in the cold season. *A. Rossii* and *A. Sinensis* were seldom found except in the town of Dinajpur, and *A. Barbirostris* was only occasionally met with. With regard to the malarial-carrying *A. Listoni*, it is worthy of note that it was not met with in Porsa at the extreme south of the district, this being also the least feverish part, nor could its larvæ be found in the river, which appeared to present favourable conditions for its presence. In Churaman also, which is also comparatively little feverish, I failed to find this variety. It would not be wise to lay too much stress on this point as the distribution of this mosquito might be much more extensive in the malarial season.

TABLE X.—VARIETIES OF ANOPHELES FOUND IN THE HOUSES.

	Dinajpur.	Balughat.	Porsa.	Churaman.	Ranienkail.	Total.
<i>A. Fuliginosus</i> ...	178	51	103	106	108	546
<i>A. Rossii</i> ...	39	5	...	...	...	44
<i>A. Listoni</i> ...	6	4	...	...	6	16
<i>A. Barbirostris</i> ...	3	1	...	1	3	8
<i>A. Sinensis</i> ...	2	...	...	...	...	2
Total ...	228	61	103	107	117	616

Dissection of Anopheles.—In addition to ascertaining the varieties of anopheles present in the houses, it is also necessary to find out by means of dissections and microscopical examinations of the salivary glands for sporozoites, which varieties are actually carrying infection. For this purpose 138 anopheles cut in the houses in Dinajpur were examined for sporozoites, but none were found. Nearly all of them were *A. Fuliginosus*, which was never found to be naturally infected by the Malarial Commission, although they showed that it can be artificially infected. More recently Major Adie in the Punjab found one of these anopheles to contain sporozoites resembling those of human malaria, but it is clear that it is not a common carrier of the disease. Unfortunately very few, *A. Listoni* could be obtained for dissection, and no sporozoites were found in them. This is not surprising, for these dissections were carried out in the cold month of January, and it is well known that a certain temperature is necessary to allow of the development of the malarial parasite in mosquitoes. In a previous paper, I showed that the number of cases of malarial fever fell off very rapidly in a suburb of Calcutta as soon as the minimum temperature fell to 60°F., doubtless for the reason just mentioned, and as the minimum temperature in Dinajpur in January was much below that point, it is not surprising that no sporozoites could be found. I had hoped to be able to ascertain if the *A. Listoni* was infected when the weather had become warmer again, and just before leaving Dinajpur in the middle of March, I tried to collect the necessary mosquitoes, but they were still as scanty as earlier in the year, so I was not able to obtain them in sufficient numbers for dissection. This point can only be settled in the rainy season, but as Dinajpur is close to Jalpaiguri, where the Malaria Commission found the *A. Listoni* to be infected later in the year than the time of my inquiry, there can be little doubt that this is the variety which is mainly responsible for the prevalence of malaria in Dinajpur and the neighbouring districts, for I also found this species in small numbers in the north-west corner of the Purnea district.

THE POSSIBILITY OF DESTROYING ANOPHELES IN LOWER BENGAL.

It will be convenient in this place to discuss the practicability of attempting in Lower Bengal to destroy those anopheles, which carry the infection of malaria as a method of malarial prophylaxis. It will be clear from what has been written above that it would be an utter waste of money and labour to attempt to destroy all the different kinds of anopheles, when only one, or possibly two of them, have been found to carry the disease in nature. Thus, it is now generally admitted from dissections of many hundred *A. Rossii* that these are never found to be naturally infected, although they can be infected by artificial means, and are thus theoretically capable of conveying the disease. For the same reason, we may exclude from our consideration the swamp species which very rarely enter houses, and have also not been yet found to be naturally infected. This leaves us with only the *A. Fuliginosus* and *A. Listoni*, the former of which has only once been found naturally infected in the Punjab, while there it almost disappears before the fever season begins. If it proves to have a similar seasonal distribution in Bengal, it may also be excluded from consideration as not being of any material importance in the etiology of malaria. Some three years ago, a plan for destroying anophele mosquitoes in Calcutta was initiated under the idea that they only bred in small pools, which could be easily dealt with, as suggested by Major Ross. At that time I made a careful search for the breeding places of anopheles month by month for more than a year in a selected area in a suburb of Calcutta, with the result that I found them to be breeding in enormous numbers in nearly all the tanks during the hot weather months, that is at the time

of the minimal malarial season. On the other hand, they were much fewer in number during the rainy malarious time, but their distribution was then different the tanks being free from them, while the chief breeding places were small pools and more especially the shallow uneven earth drains on each side of every road. Moreover, in these roadside drains varieties of anopheles which can carry malaria were found, whereas those which had swarmed in the tanks at an earlier period were all *A. Rossii*, which we now know (8) are harmless, as far as the spreading of malaria is concerned. The measures which were being taken for destroying the *A. Rossii* in the small pools and tanks, then, were only money thrown away as far as malarial prophylaxis was concerned. This example is mentioned to show that great circumspection is required in recommending measures for destroying anopheles in Lower Bengal.

A still more instructive example is that of the measures which have been carried out under the directions of members of the Malaria Commission during the last two years at great expense, to test the practicability of destroying anopheles in a portion of the very malarious cantonment of Mian Mir (10), the results of which have recently appeared. In this place, the chief breeding ground of the malaria-bearing variety was the irrigation canals which traverse the cantonment. The results of these operations will be familiar to the Sanitary authorities, but briefly it may be said that the elaborate measures carried out persistently for two years resulted in only a slight diminution of the number of anopheles in the houses of the treated area. On the other hand, much good was obtained by prophylactic issue of quinine, and still more marked effects were got by treating all the children in a syce line in this way, malaria being nearly absent from both the children and the adults. Further, the moving of some syces from their old lines near the canals to one-half a mile or more from them resulted in an entire absence of both the anopheles and of malaria fever among them. That the total destruction of the malaria-bearing mosquitoes will prevent the fever is certain, but experience in India has proved that it is only in very exceptionally favourable conditions that this measure is practical, while it must be continued indefinitely. Such conditions were met with at Ismalia, where rain falls on but very few days of the year, and certain swamps and pools were easily permanently filled up. Here the resulting reduction of malaria has been most marked, but to attempt to apply this method to the totally different conditions of Lower Bengal and to expect similar results would be utter folly.

In view of the above facts, let us return to the conditions met with at Dinajpur. Here we have the malaria-bearing *A. Listoni* breeding throughout the course of two streams, one on either side of the town, and probably also in the rainy season in the numerous subsidiary streams which flow into the main one during that time. To attempt to destroy the larvæ in these rivers throughout the rainy season is obviously utterly impracticable. Something may be done by steadily extending year by year the brick lined drains through the main streets, so as to do away with the stagnant earth-lined drains, the bottoms of which it is almost impossible to keep sufficiently level to prevent water standing in them. Further within the municipal limits the formation of borrow pits during road-making by the Public Works Department should not be allowed, as at present, for they form excellent breeding grounds in the rainy season. These measures are only applicable to the town itself, and do not touch even the smallest proportion of the total population of the district, among whom it is quite impracticable to attempt to destroy the malaria-bearing anopheles. It is quite clear, then, that some other measure than mosquito destruction must be relied on.

THE VILLAGE DISTRIBUTION OF QUININE.

Where it is found impossible to destroy the intermediate host of the malarial parasite, namely, the malaria-

carrying varieties of anopheles, the only other practical method of malaria prophylaxis is the destruction of the parasites during their cycle in the human subject. This can only be done by efficient doses of quinine, so that the problem resolved itself into one of devising a practical scheme of village distribution of quinine. It has already been mentioned that the administration of quinine regularly as a prophylactic to the children of a syce lines in Mian Mir not only saved nearly the whole of them from malaria, but was also effective in preventing the infection of any of the adults in the same lines, although these latter took no quinine whatever, because adults are infected by mosquitoes, which have first derived the infection from children as a rule. I have also shown in an earlier part of this report that the main death-rate from acute malaria is among children during the few months of the rainy season, and immediately afterwards. If these could be adequately treated with quinine as soon as they developed fever (for its prophylactic distribution to children in villages is as yet beyond the region of practical policy), not only would the main source of death-rate from malaria be stopped, but at the same time there would be much less infection among adults, and fewer deaths from chronic malaria and from other diseases such as pneumonia, dysentery and phthisis, which so often attack those debilitated by previous malaria.

In discussing this important question we must first consider how far the present agencies for the distribution of quinine meet the necessities of the case. They are the dispensaries, private practitioners and the post offices. That the dispensaries effect great good by the treatment of fevers with quinine was abundantly evident throughout my inquiry, for in every place where there was a flourishing dispensary the spleen-rate was considerably lower than it was in the neighbouring villages, the differences being much greater than could be accounted for by the position of the dispensary on a slightly higher and more healthy site in some instances. The difference was most marked among the children of the more intelligent classes, for it was particularly marked among the children attending the larger schools. The most striking example met with was that of a school at Churaman which stood next to the dispensaries, for among 31 children only two had any enlargement of the organ, or 6 per cent., by far the lowest rate met with in the district. In this instance I ascertained from both the School Master and the Hospital Assistant that the boys were regularly sent to the dispensary from the school when they were found to be getting fever. In Balughat a very similar state of affairs was found. As it was not uncommon for about one-third of the children attending the school to be down with fever at one time in the rainy season, it is clear that they must most of them have been treated during the year. The Civil Surgeon, Captain Megaw, R.M.S., had been struck by this fact before my arrival in the district, and my own experience amply confirms his. The range of such a dispensary unfortunately is seldom more than two or three miles, or five at the outside, so that the quinine distribution of seven dispensaries among the one and-a-half million persons in the district of Dinajpur is scarcely more than a grain in an extensive sandy desert, and any practical increase can only be a matter of very slow growth. Private practitioners abound in Dinajpur itself, and although a large proportion of them profess homœopathy, yet they doubtless do some good in the treatment of fevers. In the district itself, however, they are almost a negligible quantity.

Turning next to the post office distribution, I found that there are but 40 post offices to very nearly 4,000 square miles, or one to every 100 square miles. Further seven of these are in the same places as a dispensary is situated. During 1903, throughout the whole district only 8,064 packets of the drug were sold among 1,500,000 people, although my enquiries showed that the great majority of the population suffer from fever repeatedly in each year. These figures will suffice to bring home

the fact that the infinite majority of the population of Dinajpur, and doubtless of all other malarious districts of Bengal, are beyond the reach of the one drug, which will save their lives when attacked by malaria, to say nothing of an infinite amount of suffering and loss, while thousands of children die yearly, whose lives could be saved with absolute certainty if quinine were readily available for their treatment.

My object in laying stress on this fact, which is only too well known, is because my enquiries have led me to believe that something can and ought to be done to remedy this cruel loss of life from malaria, specially among children. Some of the dispensaries do not do all they might, the stock of quinine supplied being often utterly inadequate, while it is occasionally allowed to run perilously low, with the result that it is not dispensed when it should be, as in one case only six drachms were in hand at the time of my visit, but this is a matter for administrative care. Perhaps more quinine would be used if the good an outdoor dispensary does was measured by the amount of quinine dispensed rather than by the number of petty operations performed, but still any improvement thus effected would only touch the fringe of the question. What is really wanted is some system of distribution of the drug in every village. I have discussed with the district postal authorities the possibility of a more extended distribution of the drug through the postal peons on their visits to the villages, and I am of the opinion that something might be done in this direction by giving a small commission to these agents in order to stimulate the sale of the pice-packets. Still it appears that many small villages and hamlets may not be visited for weeks at a time by the postman, especially during the rainy fever season when communication is at its worst, and some new agency actually residing in the villages themselves is necessary if any real success is to be obtained. Such an agent should be somewhat more intelligent than the village chaukidar, whose burden is already quite as much as he can bear, and should also, if possible, be in close touch with the children, whom it is particularly desired to reach. Such a man is the village school master, for a primary school is now to be found in nearly every village or group of villages, and it would be to the advantage of the master to get his pupils to take quinine whenever they get fever, for he is interested in keeping up the figures of his attendance roll, which is greatly affected by absence on account of malarial fever in the rains. I am informed that the masters of the primary schools get only about Rs. 10 a month, so they would not be above accepting a small commission on their sales, which would encourage them to do their best in the matter. The headman of the village might in some cases also be enlisted among the dispensers of quinine. I have spoken to many intelligent natives, both official and unofficial about this plan, and they have all approved of its being given a trial. Whether it would be advisable to supply packets free to the schools or to sell them below cost price at first in the most malarious tracts is rather difficult to decide, as it might lead to purchase for the

sake of selling again at a higher price, while difficulties might arise when the drug had become sufficiently popularised to make it advisable to raise the price to its cost point. I think, however, some packets might be supplied free to the schools. This is a matter for the sanitary and administrative authorities to settle, but that some system of village distribution of quinine among the children more especially, is an urgent necessity if the heavy death-rate from malarial and chronic cachexial fevers is to be lessened, is quite certain, for it is the only practical method of prophylaxis in the swampy mosquito swarming tracts of Lower Bengal.

AN OUTBREAK OF TRUE BERI-BERI AMONG THE STUDENTS AT TURA, GARO HILLS, ASSAM.

By REV. G. C. CROZIER, M.D.

BEGINNING in May of last year there has been a serious outbreak of beri-beri among the students here. If it is not this disease, I should be glad to have somebody put me right. The following record of cases gives most of the striking characteristics as the disease has appeared. Never having seen the disease before and the acute form appearing here being so different from the picture of the disease I had gotten from American text-books, the first two cases died before the disease was identified. I then took the third case over to the Civil Surgeon, Dr. Banerjee, just transferred from here, and he questioned if it might not possibly be beri-beri. From the available literature on the subject, English, American, and Indian, I became convinced that I was dealing with true beri-beri, and so at once sent the cases away from here on the recommendation of some authors familiar with the disease in India. It was concluded to be specially necessary to do so, as I had no suitable quarters for caring for such cases. All but three of those sent home have passed the acute critical stage and several have "recovered"; but one died after two weeks marked improvement in his condition, whether from an acute relapse of a few days or from some other disease, I have not been able yet to learn.

I have been unable to come to an opinion as to probable or possible cause, or source of the disease. Some have said that at the south side of the district in a village from which some of the students came, there were several sudden deaths from the "same disease," and from the north are some other reports also unreliable. Certain it is, that there was over-crowding in very dirty lines, but the second death was a case in an uncrowded, well-ventilated, and (for natives) fairly clean room in a line with board floor, bamboo walls and thatch roof, and the first death was from the same line but in a crowded room. This line is elevated on posts five feet from the ground on the crest of a hill. Other cases occurred among the students in this line, several in the other two lines with earth floor, and others in private houses on the hillside just back

¹ Donovan, *Indian Medical Gazette*, December 1903.

² The differentiation of the continued and remittent fevers of the tropics by the blood changes. *Trans. of the Medical Chir. Soc.*, 1903, and *Lancet*, Volume I, 1903.

³ Report on Kala-dukhi by Major Harold Brown, I.M.S., 1898, and in *Indian Medical Gazette* of 1898.

⁴ Bentley on Epidemic Malta fever in Assam, *Indian Medical Gazette*, September 1902.

⁵ Is malarial cachexia purely malarial? *Indian Medical Gazette*, October 1902.

⁶ Note on Kala-azar by Dr. J. Dodds Price, *Indian Medical Gazette*, October 1st, 1902.

⁷ Kala-azar successfully eradicated from tea gardens by segregation measures. *British Medical Journal*, September 1898, and *Trans. Medical Chir. Soc.*, 1899.

⁸ Reports of the Malaria Commission of the Royal Society.

⁹ Adie, *Indian Medical Gazette*, 1903.

¹⁰ Report on anti-malarial measures at Mian Mir. *Scientific Memoirs*, New Series, No. 6, by S. P. James.



